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A SYSTEM OF TENANT FARMING AND ITS RESULTS.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
- OFFICE OF THE CHIEF,
Washington, D. C., February 6, 1911.

SIR: I have the honor to transmit herewith and to recommend for publication as a Farmers' Bulletin a manuscript entitled "A System of Tenant Farming and Its Results," prepared by Mr. J. W. Froley, Assistant Agriculturist, and Mr. C. Beaman Smith, Agriculturist, under the direction of the Agriculturist in Charge of the Office of Farm Management of this Bureau.

Respectfully,

WM. A. TAYLOR,
Acting Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction.....	3
Why tenant farms deteriorate.....	4
Advantages and disadvantages of tenant farming.....	4
Fundamental principles of tenant farming.....	5
An example of tenant farming.....	6
The estate and the system.....	6
The cropping system followed.....	7
The four-field system.....	7
The five-field system.....	8
Terms of rental.....	9
Live-stock management.....	10
Returns to tenant and owner.....	11
Yields of corn and wheat on the estate.....	12
Relation of the farming system to fertility.....	15
The value of system.....	17
Possible improvement of the system.....	19
Distinctive features of the system.....	19
Systems for tenant farms.....	20

A SYSTEM OF TENANT FARMING AND ITS RESULTS.

INTRODUCTION.

It is a well-managed farm that pays the owner fair wages and 5 per cent interest on the investment while keeping up the fertility of the soil. Some farmers make considerably more than this. A much larger number make less.

By basing calculations on the yields from a few of the best fields, or on the returns from, especially favorable seasons, or on a few of the best live stock, it is possible to figure out large profits in farming. Likewise, by assuming better business management for the farm, comfortable theoretical profits are worked out. Nevertheless, in actual practice and for many reasons not foreseen at the outset the average profits in farming, aside from the rise in value of the land itself, are not large, but on the other hand extremely modest.

The most profitable farms are usually those managed by the owner living on them. Should the owner tire of farming and move away or buy or inherit a farm and attempt to run it at a distance by hired labor, he generally finds the results distinctly unsatisfactory and soon decides to sell or rent the farm.

There are many good reasons, however, for not selling the farm. Land is usually a very safe form of investment. It neither burns up nor absconds. It may appreciate enough in value as the country becomes settled to pay interest on the investment, even if no crops are grown. In any event, it will, if paid for, always furnish a home and an opportunity of earning a living. Therefore men part with farm lands reluctantly.

Rather than sell the farm or attempt to run it at long range with hired help, some method of renting it is tried. The owner comes to believe that results will be better and that he will get larger returns if he puts the farm in the hands of a tenant who has a more direct interest in its output than a hired man. In this direction also disappointments are frequent.

Disappointments in tenant farming arise because of (1) the too frequent lack of an equitable adjustment of the returns of the farm

between owner and tenant; (2) the lack of well-laid plans for keeping up the yields and the productiveness of the farm through the years; and (3) short-term leases, which keep the tenant in an unsettled frame of mind as to the permanency of his tenure and lead him to endeavor to get as much out of the land each year as possible, with little or no attempt at soil improvement or wise farm management, thus contributing to the deterioration of the farm.

WHY TENANT FARMS DETERIORATE.

In tenant farming there are two main reasons why farms usually deteriorate: (1) The owner desires as large a share as possible of the profits of the farm and frequently hesitates to put any large portion of the profits back on the farm in the way of permanent improvements or in keeping up the place, and (2) the tenant regards the farm primarily as a means of acquiring enough money to buy one of his own, and conducts the rented farm along the line of the greatest immediate financial returns to himself. It is the farm that suffers in each case. The generally decreasing returns soon bring discontent both to owner and tenant, and frequent changes of tenant follow.

A proper and equitable adjustment between owner and tenant is not easily made, but is the end to be sought. It would insure more permanent tenancy. It would relieve the owner of the duties of management and the tenant of the burden of acquiring large capital before he goes into business for himself.

ADVANTAGES AND DISADVANTAGES OF TENANT FARMING.

Speaking generally, tenant farming is not a type to be encouraged in America. Small farms tilled by their owners are regarded as the ideal, because such farms tend to build up a conservative, home-loving people. Nevertheless, tenant farming is here. It is a fact. There is, besides, a place for tenant farming in American agriculture. Cheap, fertile farms are largely a matter of the past. The homesteads of the West are practically gone. If a young man desires to go into farming in these days, he requires considerable capital. It takes a long time, working out by the day or month, to acquire that capital, and good land is expensive. If he wishes to buy a farm, it usually takes all the money and credit at his command to buy the land alone.

The acquisition of the land is only the beginning of the struggle. Investigations have shown that in farming only about half the capital required is invested in the land. The remainder is invested in buildings, fences, farm machinery, tools, and live stock, sufficient cash being kept on hand for running expenses. Many a man buying a farm will put all his money into the land and then struggle the

remainder of his life with insufficient working capital, trying to meet expenses and make the farm earn its equipment. A mere existence rather than a living is too often the result.

Should the same man let some one else furnish the farm and put his own money into the working and proper handling of it he would require much less capital. He would be relieved of a large burden of debt, and with adequate equipment and cash on hand the farm would be run far more efficiently and, generally, to his greater profit.

There is a place, then, in our present agricultural system for tenant farming. A man who has acquired some money, as a laborer or otherwise, who desires to be independent but who has not sufficient money or credit to buy and efficiently equip a complete farm, may let some one else furnish the farm while he furnishes the labor and part or all of the equipment and other working capital. Whether the results of such an arrangement are mutually satisfactory depends upon several factors, which may be profitably considered more in detail.

FUNDAMENTAL PRINCIPLES OF TENANT FARMING.

It is difficult enough to make a farm pay even when the owner runs it himself and receives all the profits. As commonly handled, it is increasingly difficult to make the farm pay when run by a tenant who has little or no financial interest in it and when the profits are divided. The owner may make the farm pay through long hours of hard work, by saving, by careful regard for his stock, and by the distribution of crops and manure so as to keep up the productiveness of all the farm. He seeks to keep up the place so that the farm will present a good appearance and increase in value. With a tenant who has only an immediate interest in the farm, some more definite plan must be adopted if the farm is to pay both owner and tenant.

Some of the guiding principles essential to success in tenant farming follow:

1. A cropping and fertilizing system which will return satisfactory yields of each crop yearly and still maintain permanently the productiveness of the farm throughout future years must be provided. The owner should make the plan.

2. Terms of agreement as to rental must be fair to both owner and tenant. If advantage is taken by either owner or tenant of a lack of knowledge in the other of what is a fair adjustment of the returns from the farm, the results are bound to be unsatisfactory and the relationship brief.

3. The terms of the lease should be such as to lead to permanent tenancy. A tenant can not and will not do his best by the farm if

he is to remain on it for only a short period. As a tenant he must be made to feel that his position is permanent just as long as he does the square thing by the farm and the owner.

While it is easy to say that tenant farming should be wisely planned with reference to large yields of paying crops and permanent maintenance of the fertility of the soil, it is not so easy to make that plan. American farmers have not long been thinking about permanently productive farms. In the past it has been simpler to abandon the old fields when they failed to produce satisfactory crops and clear new land, or perhaps to move farther West and buy a new farm. The time has come when it will be necessary to keep productive the fields now farmed. Cheap new lands are practically a thing of the past, and more and more must attention be given to kinds of farming that are permanent rather than exploitive, that will yield as well for the son as for the father.

AN EXAMPLE OF TENANT FARMING.

THE ESTATE AND THE SYSTEM.

In the older sections of the eastern United States the necessity for considering permanent types of farming has long been felt and much effort has been made to meet the need. A very good example of success in solving this problem along general farming lines is that of a large estate in eastern Maryland. This estate is the more interesting because it represents a system embracing 56 tenant farms under one ownership that has been in successful operation for more than 30 years. During this period yields of wheat and corn, which are the principal crops grown, have been maintained and in some cases increased. A large number of tenants have been on the estate for more than 20 years; several have been there for more than 30 years, and their sons have succeeded them.

These facts show clearly that the relationship between owner and tenant has been satisfactory. This is further brought out from the standpoint of the tenant by the fact that many tenants have made enough money by farming on the estate to buy farms of their own. In several instances, however, they are so well satisfied that they continue as tenants and rent their own farms to some one else.

On the other hand, the estate itself is fairly well satisfied. It has been able to keep up the productiveness of the different farms until many of them yield better than when bought. Attractive dwellings and substantial barns have been maintained on every farm, and all the fields are well fenced with board, hedge, or wire. Many fields have been enlarged by clearing waste places and made more productive

by underdraining with tile. Every farm is clean, neat, and attractive in appearance.

The returns from the farm have paid for all these improvements, have paid all taxes, and are now bringing in to the estate more than 5 per cent interest on the total investment. Some of the farms have nearly trebled in value in the last 30 years. These returns to both tenant and owner are unusual. It is seldom that so large an estate is handled so satisfactorily, and a closer study of the system followed may prove profitable.

In detail, the estate consists of 15,630 acres, or about 24 square miles of land, subdivided into 56 farms varying in size from 98 to more than 1,000 acres, an average of about 279 acres per farm. These farms are scattered over a radius of about 12 miles from the central office. Considerable areas of waste land are found on some of them, so that on the average only about 72 per cent of the land is in actual cultivation. The price of cultivated land away from the influence of towns varies from \$40 to \$65 per acre, and these farms will probably show a like variation in value. The soil of most of the farms varies from a sandy loam to a clay loam, is comparatively free from stones, and is generally well adapted to wheat culture. The land is sufficiently level for the operation of labor-saving machinery.

One of the interesting facts relative to these farms and their organization into a profitable system of farming is that they were accumulated one at a time and organized by a merchant who had no special knowledge of agriculture, yet he formulated and put into practice over 30 years ago a system which has maintained yields and given satisfactory profits to both owner and tenants up to the present time. The latter is regarded as the most important fact in this bulletin.

At the time of the owner's death, 13 years ago, the system of farming which he put in operation had become so well established that with practically no change since then the yields of the farms have been maintained, a considerable indebtedness has been paid, the buildings and fences have been kept in a good state of repair, and a net income from the farms averaging a little more than 5 per cent has been paid to the estate.

THE CROPPING SYSTEM FOLLOWED.

The four-field system.—One of the fundamental reasons for the success attained on these farms is found in the cropping systems adopted. At the outset there were two of these systems, a four-field system and a five-field system.

In the four-field system all the cultivated land is divided as nearly as may be into four fields of equal size and a rotation followed

of (1) corn, (2) wheat, (3) clover and grass, and (4) wheat. The second crop of wheat in the rotation is sown to clover, which is plowed down the following spring for corn. The fifth year corn follows wheat and the rotation is repeated. This system gives three-fourths of the farm to grain each year (half wheat and a fourth corn), while the remaining fourth is in clover and grass for hay or pasture. Oats are sown in the spring in the strips occupied by the corn shocks the preceding fall.

In this system the wheat is fertilized with a commercial fertilizer of high-grade materials, analyzing about 2 per cent of nitrogen, 8 or 9 per cent of phosphoric acid, and 2 per cent of potash, at the rate of 300 pounds to the acre. The barnyard manure made on the place is put on the corn crop. While this system has apparently maintained the productiveness of the soil, it has proved not nearly so popular with tenants as the five-field system. Many of the tenants who at first adopted the four-field have changed to the five-field system, so that at present there are scarcely half a dozen tenants in the whole estate who are following the four-field system.

The detailed farm practice in the four-field system is about as follows: The corn is cut up and the stover fed to sheep, cattle, and horses. The corn stubble is plowed and the field seeded to wheat and timothy in the fall and clover in the spring. This seeding of grass and clover stands over a year and is pastured, and possibly some of it is fenced off temporarily and cut for hay. The sod is then plowed for fall seeding in wheat, which is again seeded with timothy, followed by an application of clover seed in the spring.

This seeding of timothy and clover is used for pasture after the wheat is taken off until the following spring, when it is plowed again for corn, thus completing the rotation. All cornstalks and all wheat straw are run through the "pound," or barnyard, as fast as they can be utilized by the stock and the manure is put on the land for corn.

The five-field system.—The five-field cropping system is very popular with tenants and is well worth studying in detail. Fifty of the farms on the estate are following this system. The rotation in the five-field system is as follows: (1) Corn, (2) wheat seeded to clover, (3) clover for hay or pasture, (4) wheat, and (5) clover for hay or pasture. This pasture is again followed by corn and the rotation repeated. As in the four-field system, 300 pounds of fertilizer, analyzing 2 per cent of nitrogen, 8 or 9 per cent of phosphoric acid, and 2 per cent of potash, are used per acre on the wheat crop, and the barnyard manure is put on the clover sod and plowed under for corn. In the handling of the corn crop the stalks are cut and shocked in the field in long, compact rows in time for wheat seeding. The following spring the land occupied by the corn shocks, about

one-twelfth of the total area of the field, is plowed and sown to oats and seeded down.

It will be noted that the five-field system differs from the four-field system in having an additional field of clover for either hay or pasture. This is one of the reasons why the five-field system is so popular with tenants, since it gives them more hay and pasture for their stock. While the total acreage of grain grown on the farm under the five-field system is a little less than it would be under the four-field system on a farm of like size, the estate believes that this extra clover crop sufficiently increases the yield on the smaller acreage planted to more than counterbalance any additional yield that might be secured with the larger grain acreage under the four-field system.

Special attention is called to the fact that in this system clover is sown with each wheat crop and that it remains but one year for either hay or pasture before being plowed under. In this way the maximum benefit of the clover crop as a nitrogen fertilizer for the soil is obtained.

The usual way of running a five-year rotation in many sections of the country is as follows: (1) Corn; (2) oats or wheat; (3) wheat; (4) hay; and (5) hay or pasture. In this system clover is sown but once in the rotation, and the second year there is usually but little left for fertilizing purposes.

TERMS OF RENTAL.

The system of rental which has proved so satisfactory to both tenant and owner, and which is followed on all the farms, is about as follows:

The agreement is drawn up for one year. If the contract proves mutually satisfactory it is continued in force during succeeding years without further attention. The owner furnishes the farm and buildings; furnishes paint for painting and lime for whitewashing buildings and fences; pays for all permanent improvements, such as the clearing of new lands or the tile draining of old lands; furnishes material for fencing; furnishes half of the fertilizer and half the seed wheat, seed oats, and seed corn, and pays the taxes on the real estate.

The tenant furnishes all tools and labor for working the place and all stock kept on the place. He also furnishes half of the fertilizer and half of the seed wheat, seed corn, and seed oats; furnishes all the clover and grass seed used, which by the terms of agreement is 8 pounds of pure clover seed per acre (though 1 to 2 quarts of timothy seed may be added); hauls material and builds fences free of expense to the estate, and applies the whitewash and paint furnished by the estate.

While the owner supplies all the buildings necessary for a general farm, he does not provide buildings which would be of use primarily for the tenant. Thus, if the tenant wanted to engage especially in dairying, the owner would derive no direct financial benefit from the industry and hence the tenant would have to put up, out of his own resources, such extra buildings as he might need.

In the division of returns the owner gets half of all the wheat, oats, and corn grown on the place, delivered free by the tenant at the elevator or nearest market. The tenant gets the remaining half of the oats, wheat, and corn, and in addition he has all of the hay and pasture, all the cornstalks, and all the straw for his stock. In case, however, any hay, straw, or stover is sold off the place the owner gets half the proceeds. In addition to this, the tenant is permitted to pasture a small flock of sheep on the wheat fields when the ground is frozen, from December to the last of March. This is of no advantage to the owner, but is of distinct advantage to the tenant.

It is a wise landowner who looks beyond a particular year to the future welfare and productiveness of the farm and makes terms with the tenant which tend to return to the soil each year a reasonable proportion of the plant food and humus removed and at the same time allows the tenant as large a measure of independence as possible. The simple provision requiring the tenant to pay the landlord half of all the money received for roughage sold off the farm, but requiring nothing if the roughage is fed to stock or left on the place, leaves the matter open to the discretion of the tenant, but inevitably tends, nevertheless, to the maintenance of a large number of stock on the place and the consequent production of a large supply of manure for the continued renewal of the productiveness of the soil.

It is now seen why the five-field system is a little more in favor with the tenant than the four-field system, since it gives him more pasture and hay, all of which he may have for feeding to stock. In this the tenant gets both the food value and the manurial value of the forage grown, while the owner gets only half of the increased grain yields obtained as a result of applying the manure produced by feeding this roughage on the place.

LIVE-STOCK MANAGEMENT.

In a system of farming such as is practiced on these farms, where the tenants are generally free to follow their own course in all matters except as to the cropping system, there is bound to be a wide variation in the management of live stock. Some of the tenants are inclined toward dairying, others toward the keeping of beef cattle, some toward the maintenance of as much stock as possible, even to the

extent of purchasing considerable feed, while others keep as little stock as they think will economically consume the roughage raised.

On one of the farms, consisting of about 275 acres, which seemed to be typical of the average, there were kept about 9 head of work stock, 12 milk cows and their calves, 50 sheep, and 100 hens. While it is generally conceded that hogs would be a good paying investment if they could be kept free from cholera, very few were found on any of these farms, owing to the prevalence of this disease in that section of the country. Scarcely enough hogs are raised to supply the farm with meat.

The work horses and mules are kept up and fed practically the year round. They are fed principally corn, corn stover, and hay. The cows are allowed to run on clover pasture from about May 1 to October 1 and are not fed unless pasture becomes very short in August and September, in which case they may be fed green fodder. From October 1 to December 15 they run on pasture, but are fed fodder and corn, and from December 15 to May 1 they are kept in the barn and barnyard and fed corn stover, wheat straw, corn, and possibly some ground grain other than corn.

The grade sheep are pastured on the green, growing wheat in suitable weather from December to March, when they are turned into the clover field to stay until October 1 or November 1, after which date they are kept in the barn and barnyard and fed principally straw, stover, and corn. The ewes are bred to lamb in January and February. The lambs run with the ewes until some time in May or June, when they are sold at weights of 40 to 50 pounds each at a price averaging about \$5.50.

Under the system of management described, this stock consumes about all the grain and forage of the farm available for the use of the tenant. A greater number of stock would make the purchase of feed necessary and a smaller number would leave a surplus of forage to be sold.

RETURNS TO TENANT AND OWNER.

The tenants on the farms of this estate are apparently as prosperous as the average farmer of the country who owns his farm. They live in commodious, substantial, and well-furnished houses, with well-kept and neat-appearing surroundings. They give their children up-to-date educational advantages. They apparently have plenty of leisure and carry on their farm work largely by means of hired labor. As an illustration of their prosperity, one of them on a farm with 250 acres in cultivation, employing 3 men 10 months in the year and keeping 10 work horses, stated that during the last

11 years as a tenant he had out of his profits bought and paid for a farm costing \$7,200 and had laid up about \$600 besides. Meantime he has lived well, is educating his children in the city schools, and has done considerable traveling over the country. Another tenant on a farm of about the same size stated that his income from the sales of stock he was able to keep, by means of his pasture and roughage, was sufficient to pay the running expenses of the farm.

Relative to the owner's income per acre, it may be calculated that an acre of land in the five years of the rotation will return to him as his share $16\frac{1}{2}$ bushels of wheat, $17\frac{1}{2}$ bushels of corn, and 3 bushels of oats. Valuing the corn at 50 cents a bushel, wheat at \$1, and oats at 40 cents, the total income to the owner from 1 acre of land in the five-year rotation is \$26.45.

The total expense of the owner on 1 acre of land for the five years of the rotation is about as follows:

Owner's expense per acre for a five-year rotation.

600 pounds of fertilizer on 2 wheat crops (owner's half) ---	\$3.00
Taxes at 1 per cent on land valued at \$50 per acre (five years) -----	2.50
Seed wheat, 3 bushels at \$1 (owner's half) -----	1.50
Seed corn, one-fourth bushel at \$1 (owner's half) -----	.13
Seed oats, one-half bushel at 50 cents (owner's half) -----	.12
Incidentals for repairs, painting, whitewashing, etc. -----	.50
Total expense on 1 acre for five years -----	7.75

Deducting the total expense, \$7.75, from the total income, \$26.45, leaves \$18.70 as the net income to the owner from 1 acre of cultivated land for one round of the rotation of five years.

The income for 1 acre of cultivated land therefore for one year would be a fifth of \$18.70, or \$3.74. However, only about 72 per cent of each farm is in cultivation. The income per acre for the whole farm will therefore average 72 per cent of \$3.74, or \$2.69 per acre. With land worth \$50 an acre this would give an average yearly income equivalent to about 5.4 per cent on the investment.

In addition to these current receipts of 5.4 per cent per annum on the present value of the farms of the estate, it is believed that at least an additional 3 or 4 per cent per annum on the original investment has accrued to the estate by virtue of the increased value of land, thus bringing the total income of the landowners up to approximately 8 or 9 per cent per annum.

YIELDS OF CORN AND WHEAT ON THE ESTATE.

That the yields of both corn and wheat have been practically maintained and the productiveness of the farms kept up under this

system of rotation and fertilizing may be seen from the following tables, in which the yields from 21 of the farms for which data were available, covering a period of 20 years, are recorded.

TABLE I.—Yields of corn per acre on the estate for 20 years.

Number of farm.	Area cultivated.	Total yield of corn by 5-year periods.			
		1890-1894.	1895-1899.	1900-1904.	1905-1909.
	<i>Acres.</i>	<i>Bushels.</i>	<i>Bushels.</i>	<i>Bushels.</i>	<i>Bushels.</i>
1.....	245	7,005	8,290	6,585	6,225
2.....	425	13,630	13,600	11,680	11,305
3.....	360	17,800	14,995	13,560	13,975
4.....	288	8,110	10,410	10,055	11,885
5.....	195	5,970	8,255	7,355	8,230
6.....	272	9,635	12,415	8,795	11,530
7.....	175	6,010	5,680	4,805	5,575
8.....	205	5,105	11,190	8,450	7,525
9.....	150	4,055	5,145	4,440	4,635
10.....	250	15,625	6,450	5,600	5,925
11.....	229	15,625	10,280	6,555	6,895
12.....	250	8,435	9,615	8,055	8,660
13.....	555	17,735	18,570	16,655	18,000
14.....	220	7,055	10,490	7,840	8,375
15.....	175	6,530	8,305	6,405	7,415
16.....	434	22,100	22,100	19,885	18,380
17.....	291	12,275	13,455	13,340	12,210
18.....	250	8,185	10,640	7,145	6,815
19.....	307	10,080	10,865	8,845	7,675
20.....	195	3,895	5,610	4,945	5,045
21.....	190	4,605	5,000	4,450	4,415
Total.....	5,659	189,465	221,360	186,445	190,690
Average annual yield per acre.....		33.5	39.0	32.9	33.7

¹ Estimated from yields given for three years in the 5-year period.

In the following discussion it will be assumed that the average of the 21 farms represents the average of the 56 farms of the estate. The table shows averages of $33\frac{1}{2}$ bushels of corn per acre for the first five-year period, 1890 to 1894, $33\frac{7}{10}$ bushels for the last five-year period, 1905 to 1909, and about 35 bushels for the whole 20 years. These yields are not large, but they were obtained on farms where the area under cultivation was about 270 acres per farm. It is comparatively easy to get large yields on a few acres, but more difficult as the farm increases in size. While the general average, 35 bushels, seems very modest, it is greater than the average of the State of Maryland for the past 20 years by 7 bushels, greater than the average for the whole United States for the past 10 years by 9 bushels, and it is also better than the average corn yields of the State of Iowa for the past 20 years, and Iowa is one of the best corn States of the Union, with a large area of almost virgin soil, while many of these Maryland soils have been farmed for more than 150 years. The table further shows that the yields of corn on these farms to-day are practically as good, after 20 years of cropping, as in 1890.

The yields of wheat on the same farms, in five-year periods, are shown in the following table:

TABLE II.—*Yields of wheat per acre on the estate for 20 years.*¹

Number of farm.	Area cultivated.	Total yield of wheat by 5-year periods.			
		1890-1894.	1895-1899.	1900-1904.	1905-1909.
	<i>Acres.</i>	<i>Bushels.</i>	<i>Bushels.</i>	<i>Bushels.</i>	<i>Bushels.</i>
1.....	245	8,348	7,316	8,109	7,337
2.....	425	13,918	17,061	13,055	12,623
3.....	360	16,774	14,492	13,010	11,250
4.....	286	8,074	8,658	8,333	10,315
5.....	195	6,500	7,001	7,368	7,119
6.....	272	9,415	10,301	10,800	9,790
7.....	175	5,420	5,406	4,776	4,872
8.....	205	7,048	6,596	6,578	6,033
9.....	150	5,911	5,774	5,126	4,911
10.....	250	² 7,833	7,800	7,600	7,360
11.....	229	5,565	8,818	8,162	7,793
12.....	250	7,585	9,831	7,960	8,559
13.....	555	14,878	16,001	17,440	17,014
14.....	220	7,501	8,158	7,810	7,777
15.....	175	6,605	6,518	7,800	5,625
16.....	434	18,659	19,175	18,387	17,385
17.....	291	12,567	14,270	12,494	11,433
18.....	250	9,077	8,036	8,878	8,287
19.....	307	10,740	12,616	10,315	9,161
20.....	195	5,397	6,079	5,626	5,781
21.....	190	3,455	5,077	4,660	5,312
Total.....	5,659	191,270	204,984	194,287	186,437
Average annual yield per acre ³		16.9	18.1	17.2	16.5

¹ About one twenty-fourth of the wheat fields was in oats. Had all the land been in wheat the yield would have been increased about three-fourths bushel per acre.

² Estimated from yield given for three years in the 5-year period.

³ Two crops of wheat were raised in each 5-year period.

Table II shows an average yield of $16\frac{9}{10}$ bushels of wheat for the first five-year period, 1890 to 1894, and of $16\frac{1}{2}$ bushels for the last five-year period, 1905 to 1909, which results are practically identical. The two years, 1908 and 1909, were both very poor years for wheat on the estate, the yields being about 30 per cent less than normal. Thus, the average yield for the first three years of the last five-year period is $18\frac{1}{2}$, while the average yield for the last two years is but $13\frac{1}{2}$ bushels. Had the last two years been normal years, the average for this whole period would have been as good as the best of the five-year periods under discussion.

However, there is a suggestion in the decreasing returns of the past three five-year periods as shown in the table, viz, $18\frac{1}{10}$, $17\frac{1}{5}$, and $16\frac{1}{2}$ bushels, respectively, which may indicate that possibly the yields are actually decreasing and that the system of farming followed needs to be modified to meet this condition. This point will be considered again in the discussion of the fertilizer constituents removed in this system of farming.

The average yield of wheat on the estate for the past 20 years, $17\frac{1}{5}$ bushels per acre, is found to be larger than the average yield of

wheat in Kansas for the same period, $2\frac{1}{2}$ bushels greater than the average yield in Maryland, and 3 bushels greater than the average yield in the United States for the past 10 years.

While the above yields of corn and wheat are not fancy nor in any sense to be considered as models, they point out the fact that a good system well followed will maintain the fertility of the soil even in tenant farming.

The foregoing 21 farms were not selected from among either the best or the poorest of the 56 farms of the estate. The originator of the estate died in 1897 and a large number of the farms were bought in the later years of his life. The 21 farms where yields are given are the only ones for which records are available for 20 years or more, and, while the average yields for these farms seem to be very modest, yet they are greater than the averages secured in some of the best wheat and corn States.

RELATION OF THE FARMING SYSTEM TO FERTILITY.

Observing the tables presented showing yields of wheat and corn it will be seen that the land produces almost the same as it did 20 years ago. It will be interesting, therefore, to examine the situation as to the relative quantities of plant food taken from the land by the removal of crops and returned to the land by the application of commercial fertilizers and the return of manures.

The following table shows the yield of crops and fertilizer constituents in part required to produce them:

TABLE III.—Average yield on 1 acre of each crop in the rotation, with the quantity of fertilizer constituents removed.

Crop.	Average yield per acre.	Total fertilizer constituents removed.		
		Nitrogen.	Phosphoric acid.	Potash.
		Pounds.	Pounds.	Pounds.
Corn.....	Grain, 35 bushels.....	33	12	7
	Stover, $1\frac{1}{2}$ tons.....	25	16	29
Wheat.....	Grain, 17 bushels.....	19	5	8
	Straw, 1 ton.....	11	2	6
Clover.....	$1\frac{1}{2}$ tons.....	60	17	55
Wheat.....	Grain, 17 bushels.....	19	5	8
	Straw, 1 ton.....	11	2	6
Clover.....	$1\frac{1}{2}$ tons.....	60	17	55
Total plant food utilized on 1 acre in the rotation.....		238	76	174

The table shows that in one round of the rotation the fertilizer constituents required to produce the crops grown on an acre are about 238 pounds of nitrogen, 76 pounds of phosphoric acid, and 174 pounds

of potash. If all the crops were sold off the farm this would indicate in a measure the rapidity with which the farm was being depleted of its principal plant foods, with the exception of nitrogen; but in the system of farming followed all of the hay, wheat straw, clover, and about one-fourth of the corn is left or fed on the place.

All the wheat grown and about three-fourths of the corn are sold off the place. The fertilizer constituents left on an acre in a five-year rotation are therefore about as shown in the following table:

TABLE IV.—*Approximate quantity of fertilizing constituents left on 1 acre in a 5-year rotation.*

Rotation.	Returned to the soil per acre.	Total fertilizer constituents contained.		
		Nitrogen.	Phosphoric acid.	Potash.
		Pounds.	Pounds.	Pounds.
Corn.....	{Stover, 1½ tons.....	25	16	29
	{Grain, 9 bushels.....	8	3	2
Wheat.....	Straw, 1 ton.....	11	2	6
Clover hay.....	1½ tons.....	60	17	55
Wheat.....	Straw, 1 ton.....	11	2	6
Clover hay.....	1½ tons.....	60	17	55
Total.....		175	57	153

A large part of the crops shown in the above table is fed to stock or used for bedding in stables, and in this way finds its way, through the manure that is produced, back to the fields. In this process, however, the stock take toll of each substance for the building up and maintenance of their own bodies. Besides, nearly half of the fertilizing value of the manure excreted by animals is found in the liquid portion, much of which, under the system of housing followed on this estate, is made and lost in the barnyard. In addition to this there is considerable loss of manure from weathering. It is probably safe to assume that at the most not over three-fifths of the fertilizing constituents of these crops, as shown in Table IV, viz, 105 pounds of nitrogen, 34 pounds of phosphoric acid, and 92 pounds of potash, will be returned to the soil. In addition to the return of these quantities of fertilizing constituents to the soil, it will be remembered that in the rotation each of the wheat crops receives 300 pounds of a 2-8-2 fertilizer. The quantity thus returned to the fields in manure and in the fertilizer applied is shown in the following table:

TABLE V.—*Fertilizing constituents returned to fields in a 5-year rotation.*

Source.	Fertilizer constituents contained.		
	Nitrogen.	Phosphoric acid.	Potash.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
Barnyard manure, stalks, straw, etc.....	105	34	92
600 pounds of fertilizer.....	12	48	12
Total returned to fields.....	117	82	104
Total removed from fields, as shown in Table III.....	238	76	174
Quantity removed as compared with that applied.....	-121	+ 6	-70

The figures in Table V show that more nitrogen and potash are being removed from the soil than are apparently applied, while on the other hand more phosphoric acid is applied than is removed, and the soil, consequently, is growing richer in this element.

Investigations have shown that it is probably safe to assume that the two clover crops which are grown in the rotation and in large part pastured on the place will not only supply themselves with nitrogen, but will enrich the soil with this element sufficiently to supply the 121 pounds of nitrogen apparently taken from the farm and not replaced. The potash supply is regularly decreasing, but as much of the soil is a rather heavy loam and naturally well supplied with potash this comparatively slow decrease of 14 pounds to the acre per year on this character of soil probably need not be considered from the standpoint of the application of fertilizers for a number of years, except on the more sandy soils.

Summarizing briefly, then, with reference to the fertility of the farm, it is seen that the phosphorus of the soil is being maintained, that the humus and nitrogen content is probably being maintained, that the potash is being slowly decreased, but that there is probably a sufficient surplus of the latter element in all the heavier soils to supply the crop demands for years to come.

THE VALUE OF SYSTEM.

The result obtained on the estate under discussion strongly emphasizes the value of a proper system in farming. Without system the farm as a whole quite uniformly deteriorates. The comparatively slow decrease in the productiveness of many farms, accompanied frequently by variations in seasons which may result in increased or decreased yield independent of decrease of soil fertility, often blinds farmers to the fact that their farms are gradually growing less productive. Decreased productiveness is an inevitable result, however, on a large number of American farms as now conducted.

This decrease in productiveness on many American farms is due in a large measure to the fact that these farms are not properly managed. The owner frequently fails to keep records and does not know whether or not his system of farming is maintaining the yields of former periods. This he should know if he is to run his farm intelligently. He should know at the outset that his system adequately provides for all the plant food required for the production of maximum yields of crops on all his fields all the time.

If the farm is a heavy loam and has a practically inexhaustible supply of potash in the soil, then his system of cultivation, rotation, and manuring should be such as to make this potash easily available for the growing crops. If the soil is normally weak in phosphoric acid or lime, the system of farming should provide that the native supply be supplemented by outside sources, usually in the form either of feed for stock with the resulting manure returned to the soil or of fertilizers bought for the purpose.

So, likewise, economy in farming usually demands that the rotation be such that the nitrogen supply of the soil be kept up by the systematic growing of legumes, like clover, in the rotation, though occasionally, with certain crops, artificial supplies may be very profitably used.

Above all, the system of farming must provide an adequate supply of humus for the soil either by growing green-manure crops to turn under or by applying barnyard manure or other by-products of the farm, like straw, stalks, or waste roughage of various kinds. Probably more American farms give decreased yields because of an insufficient supply of humus in the soil than for any other one reason.

So far as we now know, it is not enough simply to follow a rotation of crops on the farm. That alone will not keep up yields permanently. The growing of clover in the rotation, though serving to keep up yields for a considerable period, finally fails, and can not be relied upon for maintaining a permanently productive farm. Something more, in addition to the clover, is needed. That something more is either the intelligent use of commercial fertilizers or the feeding of stock with the crops grown on the farm, supplemented by purchased feeds, and the resulting manure carefully husbanded and returned to the soil with as little loss as possible of plant food.

The cropping system on every farm should be planned so as to meet the demand for increasing productiveness as the years go by. The fertilizing constituents removed from the soil by all of the more common field crops are well known. The materials which may be used to restock the soil with the same constituents are also well known. Crops which may profitably follow each other in the rotation have been ascertained. Satisfactory systems of keeping up the humus supply of the soil have been determined. It simply remains for the

farmer, in order to make the farm productive for all time, to fit the crops he desires to grow, in the light of what is already known with reference to good farming methods, into a good rotation and to supplement from some other source any deficiency of plant food or humus in the soil which may occur as a result of growing these crops.

POSSIBLE IMPROVEMENT OF THE SYSTEM.

The system of farming on the estate under consideration was developed by a business man who had to devise methods of management that would seldom require his presence on the farm. This necessarily meant the same or a similar scheme of administration on all the farms. Every farm in the estate is, therefore, run on practically the same plan, regardless of varying soil conditions and the adaptability of the different tenants to such a type of farming. This was the easiest and perhaps the most economical method of handling so large an estate. Nevertheless, it is undoubtedly true that could each farm be operated with reference to the best development of that farm alone, considerably higher yields could be obtained. Strictly high-grade farming should make these farms yield on an average at least 50 bushels of corn and 25 bushels of wheat to the acre. A method of handling that would produce these results, however, implies constant supervision by a thoroughly trained manager, well versed in both the science and practice of agriculture. The very thin stands of clover observed on some farms and the actual results secured on a few farms indicate that in many instances lime or some other soil improver is needed for the best development of the clover crop. It is believed by many farmers in the section of country where these farms are located that lime should be applied at regular intervals.

On some of the farms of the estate having sandy loam soils it is probable that an increase in the potash supplied in the fertilizer would prove beneficial. A skilled manager would also introduce better cultural methods on some of these farms and bring in improved strains of corn and wheat. However, for a scheme of management that relieves the owner of the responsibility of details it would be difficult to devise a better plan than the one already adopted and in operation.

DISTINCTIVE FEATURES OF THE SYSTEM.

The distinctive features of the tenant system described in the foregoing pages follow:

1. The tenant is well provided with a comfortable house and with barns and other outbuildings.
2. He is encouraged to keep live stock and is supplied with equipment for fencing and shelter.

3. He is given all the roughage when he feeds it, but only half when he sells it, thus making it to his interest to feed stock and return the manure to the land.

4. He is under contract to use on certain crops fixed quantities of fertilizers of a specified formula; the quality of this fertilizer is guaranteed by the estate.

5. He must sow a given quantity of clover seed each year. This is to his advantage, as he gets the crop either for pasture or for hay, and in addition he receives the benefit of it as a soil renovator. To their own disadvantage, many farm owners neglect to sow clover when the price of seed is high or for other reasons. Under this tenant system such neglect is made impossible without violating the contract. Herein is one advantage this system may have over systems usually followed by owners.

6. He takes an interest in the farm on account of his belief in the fairness of the contract and in the permanency of his tenure.

SYSTEMS FOR TENANT FARMS.

1. A good system, with reference both to rotation and the maintenance of soil fertility, is essential to a permanently profitable farm.

2. Tenant farms are especially liable to decrease in productiveness as the years go by because of the general lack of an adequate system for maintaining their soil fertility.

3. Plans for farming are possible whereby both tenant and owner can make a fair profit and the farm still be kept permanently productive.

4. The owner should make the plan, since he is the one most vitally interested in the continued productiveness of the farm.

5. The plan should be based on: (*a*) A rotation of crops which of itself will keep up the humus and nitrogen supply of the soil over the whole farm; (*b*) a manuring or fertilizing system which will keep the soil adequately supplied with phosphorus, potash, and lime; (*c*) a division of the expenses and the returns of the farm which shall be fair to both owner and tenant; (*d*) terms of rental which shall induce permanent tenure; and (*e*) a simple system easily understood and easily carried out, based on crops and practices best adapted to the locality.



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